

# Flexible bronchoscopy under conscious sedation with midazolam and fentanyl can be safely performed by nonanesthesiologists

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**Introduction** Flexible bronchoscopy (FB) is one of the most commonly used diagnostic and therapeutic tools in current respiratory medicine.<sup>1</sup> It is an invasive method that is unpleasant for the patient and is preferably performed under analgo-sedation.<sup>2</sup> According to several studies, relieving the patient's anxiety during the endoscopic procedure shortens the time of the procedure and prevents adverse events.<sup>3</sup> There are no exact guidelines on how to perform analgo-sedation; however, most authors agree that using only topical anesthesia is insufficient and suggest using moderate sedation, previously known as conscious sedation.<sup>4</sup> This approach enables the medical personnel to stay in verbal contact with the patient and, at the same time, to relieve unpleasant symptoms. In several countries, mainly in Europe, moderate sedation in endoscopic procedures is restricted only to anesthetists despite several reports on the safety and cost-effectiveness of sedation applied by nonanesthesiologists.<sup>5-7</sup>

Between the years 2013 and 2014, we performed a prospective observational study that aimed to assess factors that influence anxiety and satisfaction in patients undergoing FB under analgo-sedation.<sup>8</sup> In this brief communication, we would like to present data on the safety of moderate sedation applied by nonanesthesiologists.

**Patients and methods** After obtaining written consent to participate in the study, we enrolled 463 consecutive patients undergoing FB at the Department of Pulmonology of the University Hospital in Krakow, Poland. The exclusion criteria were as follows: respiratory failure (defined as hemoglobin oxygen saturation [SpO<sub>2</sub>] below 90% despite oxygen therapy or need for more than 50% of oxygen in a respiratory mixture),

contraindications to use midazolam or fentanyl, diminished communication capacity, and cognitive disorders. The study was approved by the Ethics Committee at Jagiellonian University, Kraków, Poland.

In all patients, topical anesthesia was used according to current guidelines.<sup>4</sup> Most patients received a bolus of midazolam (2.5 mg) and fentanyl (0.05 mg) before the examination. If necessary, both medications were titrated in incremental doses during FB to achieve adequate analgo-sedation. The initial dose of fentanyl was not administered in 23 patients for one of the following reasons: exacerbation of chronic obstructive pulmonary disease, respiratory failure, or advanced age with several comorbidities. A bronchofiberscope was introduced through a mouthpiece 3 minutes after drug administration. During the whole procedure, vital parameters were monitored including oxygen saturation, blood pressure, and electrography; adverse events were also recorded. The level of patient sedation was continuously assessed according to the Ramsey sedation scale.<sup>6</sup> The study personnel were trained in acute life support and study nurses had specialization in anesthesia and intensive care. During the whole procedure, the patient's spontaneous ventilation was sustained with oxygen administered through a nasal cannula if needed (in 282 patients, approximately 3.5 l/min of O<sub>2</sub>). Monitoring was continued following FB until complete recovery from sedation was observed. If needed, patients were administered antagonists—flumazenil and naloxone—to reverse drug reaction. Immediate anesthesiologist support was available at all time during the study in case of need.

A statistical analysis was performed using the Statistica software (version 10.0; StatSoft, Inc.,

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**TABLE 1** Complications during flexible bronchoscopy under moderate analgesedation with main demographic characteristics of the study population (n = 463)

Parameter	Value
age, y	62 ± 14.03
sex, male/female	237 (51.19) / 226 (48.81)
duration of the procedure, min	21.78 ± 10.22
initial midazolam bolus, mg (n = 463)	2.54 ± 0.58
additional midazolam dose, mg (n = 238)	2.75 ± 1.17
total midazolam dose, mg	3.95 ± 1.72
initial fentanyl bolus, mg (n = 440)	0.051 ± 0.01
additional fentanyl dose, mg (n = 176)	0.058 ± 0.02
total fentanyl dose, mg	0.07 ± 0.04
need for antagonists	23 (4.97)
dose of naloxone, mg (n = 1)	0.4
dose of flumazenil, mg (n = 23)	0.37 ± 0.14
hypoxia: $\downarrow$ SpO <sub>2</sub> < 90% for > 30 s	65 (14.04)
hypoventilation/apnea	7 (1.51)
tachycardia > 100 bpm	114 (24.62)
bradycardia < 60 bpm	10 (2.16)
BP < 90/60 mmHg	3 (0.68)

Data are expressed as mean ± standard deviation or as the number (percentage) of patients.

Abbreviations: BP, blood pressure; n, number of patients; SpO<sub>2</sub>, hemoglobin oxygen saturation

Tulsa, Oklahoma, United States). Data were expressed as mean ± standard deviation or as the absolute number with percentage distribution. The  $\chi^2$  test was used to make comparisons between the groups (with Yates correction if applicable); *P* values of less than 0.05 were considered statistically significant.

**Results** The basic characteristics of the patients and data concerning the procedure, including drug dosing and adverse reactions, are presented in **TABLE 1**. When adverse reactions were analyzed according to sex, decreased SpO<sub>2</sub> was observed more frequently in women than in men (17.7% vs 10.6%; *P* = 0.03). In procedures lasting longer than 30 minutes (n = 58), antagonists were required more often than in shorter procedures (10.3% vs 4.2%; *P* = 0.04). Patients who received doses of midazolam higher than 5 mg (n = 50) also needed reversal drugs more often than patients who received lower doses of midazolam (16% vs 3.3%; *P* = 0.008). No difference was observed in adverse reactions or drug dosing according to age. None of the patients died or required intubation with mechanical ventilation.

**Discussion** There is an ongoing discussion on the use of analgesedation for short-lasting endoscopic procedures such as FB by nonanesthesiologists. FB is most commonly performed by chest physicians under moderate “conscious” anesthesia. Moderate anesthesia is defined as sedation during which patients stay in verbal contact with medical personnel (sometimes with mild stimulation) and do not require additional interventions to maintain spontaneous ventilation.<sup>7</sup> The

most common sedation/analgesic drugs are benzodiazepines and opioids. Some researchers have also suggested that the use of propofol instead of benzodiazepines is preferable because of a more rapid patient’s recovery.<sup>9</sup> These drugs proved to be safe in several studies used by nonanesthesiologists,<sup>5–7</sup> and are recommended by most gastroenterology and respiratory societies to use for moderate sedation in various endoscopic procedures.<sup>4,10,11</sup> Despite this, anesthesiology societies have raised several safety concerns, especially regarding the use of propofol<sup>12</sup> by nonanesthesiologists, and the use of moderate sedation has not been legally approved in many countries (including Poland), being restricted solely to anesthesiologists. One of the main concerns of is the anesthesiologists concept of the continuum of sedation, which means that the patient’s sedation status can change anytime during anesthesia and advance to deeper anesthesia, which requires mechanical ventilation support.<sup>10</sup> Physicians dealing with moderate sedation should be aware of that fact and know how to react immediately. Several countries have implemented training programs for nonanesthesiologists on how to safely perform the procedure.<sup>13,14</sup>

In the current study, we reported our findings on the safety of moderate anesthesia used during FB by nonanesthesiologists. Even though most of the patients requiring FB are in severe general condition, the procedure proved to be safe, with a relatively few complications that were immediately reversed.

In our study, we used analgesedation with midazolam and fentanyl. These drugs have a relatively safe profile, and if titrated in small incremental

doses and adjusted for comorbidities, age, and other factors, they rarely cause complications. Nevertheless, it has to be emphasized that proper monitoring of patients and the presence of experienced personnel are absolutely mandatory to perform the procedure. Medical personnel should be familiar with the use of antagonists and reversal procedures in case of emergency. The most severe complications due to oversedation are respiratory depression (hypoventilation/apnea) and cardiovascular depression (especially bradycardia). These complications occurred in a few patients during the study period and were immediately reversed.

In conclusion, FB can be safely performed under moderate anesthesia by nonanesthesiologists. With the widespread use of endoscopic techniques, there is a strong need for discussion between internal medicine and anesthesiology societies with the aim to develop safety protocols and training programs in moderate sedation in Poland. Additionally, there is a need to legally approve moderate sedation for use by trained physicians other than anesthesiologists.

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